Roaring Brook Watershed Summary

Angus Park Pond

Watershed Description and Maps

The Roaring Brook watershed covers an area of approximately 11,826 acres in the central area of Connecticut (Figure 1). There are multiple municipalities located at least partially in the watershed, including the city of Manchester and Town of Glastonbury.

The Roaring Brook watershed includes one segment impaired for recreation due to elevated bacteria levels. This segment was assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2010 303(d) list of impaired waterbodies. Several segments in the watershed were currently unassessed as of the writing of this document. However, this does not mean there are no problems on these segments, but is an indication that there is not current data to evaluate the segments as part of an assessment process. An excerpt of the Integrated Water Quality Report is included in Table 1 to show the status of some of the other waterbodies in the watershed.

The bacteria impaired segment, Angus Park Pond (CT4009-00-2-L4_01) is located in Angus Park within central Glastonbury. The pond is 9.35 acres (Figure 4). Angus Park Pond's impaired segment ends where its outlet flows into Roaring Brook just north of Fisher Road in Glastonbury.

Angus Park Pond has a water quality classification of A. Designated uses include potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. This segment is impaired due to elevated bacteria concentrations and the designated use affected by the impairment is recreation. Angus Park Pond has a designated beach, so the specific impaired for Angus Park Pond is for recreation for designated swimming and other contact water-related activities.

Impaired Segment Facts

Impaired Segments Name: Angus Park Pond (CT4009-00-2-L4_01)

Municipalities: Glastonbury

Impaired Segment Length / Area: CT4009-00-2-L4_01 (9.35 acres)

Water Quality Classification: Class A

Designated Use Impairment: Recreation

Sub-regional Basin Name and Code: Roaring Brook, CT4009

Regional Basin: Connecticut Main Stem

Major Basin: Connecticut

Watershed Area (acres): 11,826

MS4 Applicable? Yes

Figure 1: Watershed location in Connecticut

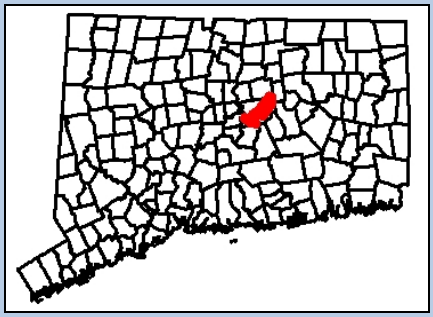


Table 1: Impaired Segment and nearby Waterbodies from the Connecticut 2010 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles/ Acres	Aquatic Life	Recreation	Fish Consumption
CT4009-00_01	Roaring Brook (Glastonbury)-01	From mouth at Connecticut River US to Angus Park Pond dam at outlet (Angus Park Pond NOT included).	6.73	FULL	NOT*	FULL
CT4009-00_02	Roaring Brook (Glastonbury)-02	From Angus Park Pond inlet, East Glastonbury, US to Buckingham Reservoir outlet Dam Buckinham Reservoir NOT included).	2.79	FULL	U	FULL
CT4009-00_03	Roaring Brook (Glastonbury)-03	From Buckingham Reservoir inlet (Buckingham Res. NOT included), US to headwaters (Segment entirely within Manchester drinking water supply watershed).	2.38	U	U	FULL
CT4009-00-2-L4_01	Angus Park Pond (Glastonbury)	Impoundment of Roaring Brook, east of Rte 83 Glastonbury.	9.35	U	NOT	U

Shaded cells indicate impaired segment addressed in this TMDL

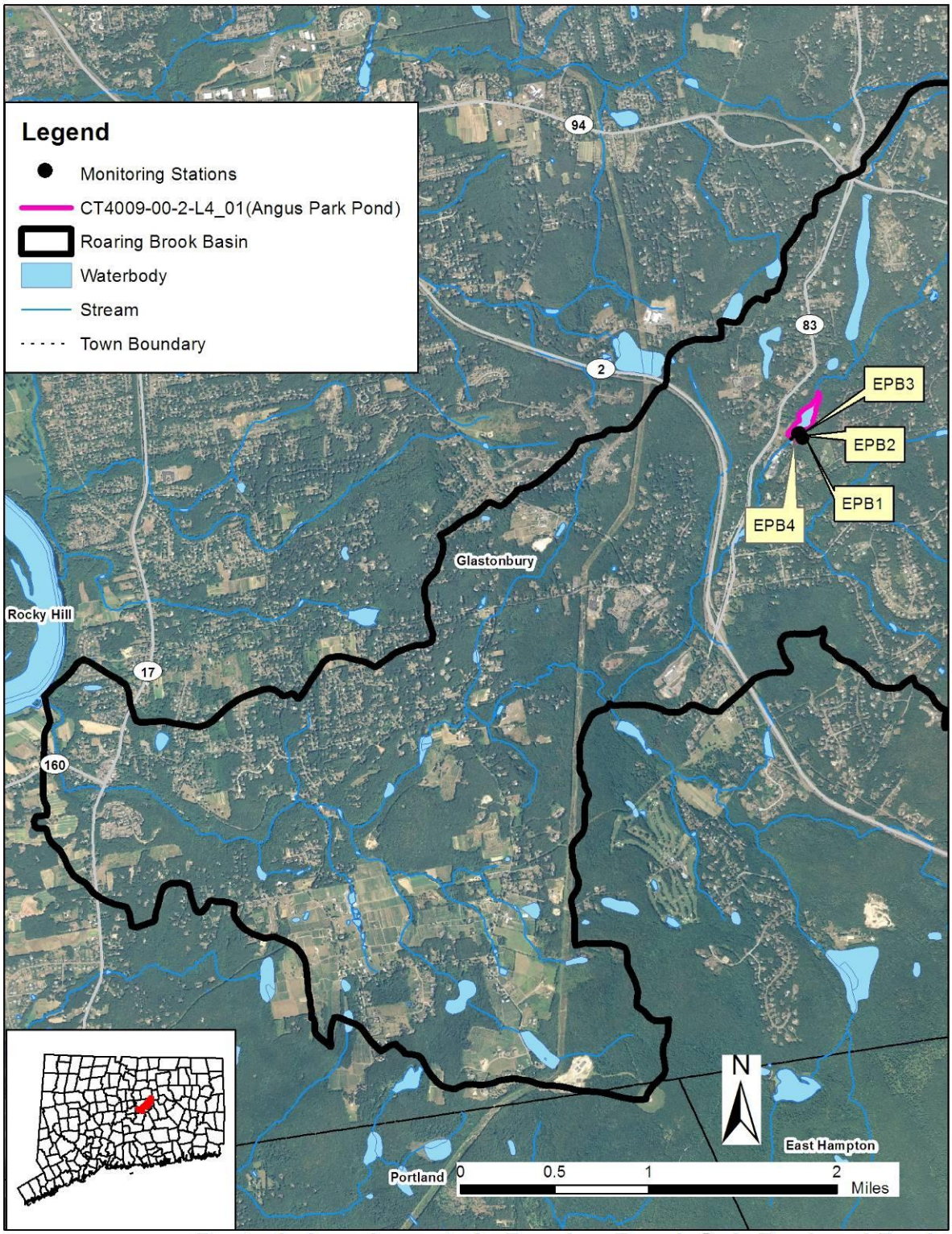
FULL = Designated Use Fully Supported

NOT = Designated Use Not Supported

U = Unassessed

*= Recent data shows that this segment actually meets Water Quality goals for recreation in 2012

Figure 2: GIS map featuring impairment information of the Roaring Brook watershed at the sub-regional level



Bacteria Impairments In Roaring Brook Sub-Regional Basin
Map Data: DEEP Map Created: December 2011

Land Use

The existing land use in a watershed can affect the water quality of the waterbodies within that watershed (USEPA, 2011c). In an undeveloped watershed, natural processes such as infiltration of stormwater into the soil and plant uptake of water and nutrients can occur. As watersheds become more developed with commercial, residential, and industrial land uses, the amount of stormwater runoff increases as the natural landscape is altered with impervious surfaces, such as rooftops, roads, and sidewalks. The amount of pollutants, such as nutrients and bacteria from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities, can also increase, can become entrained in this runoff, and negatively affect nearby waterbodies. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011c).

As shown in Figures 3 and 4, the Roaring Brook watershed consists of 68% forest, 21% urban area, 8% agriculture, and 3% water. The portions of the watershed in Glastonbury surrounding Angus Park Pond are a mix of forested and urban land uses.

Figure 3: Land uses within the Roaring Brook watershed

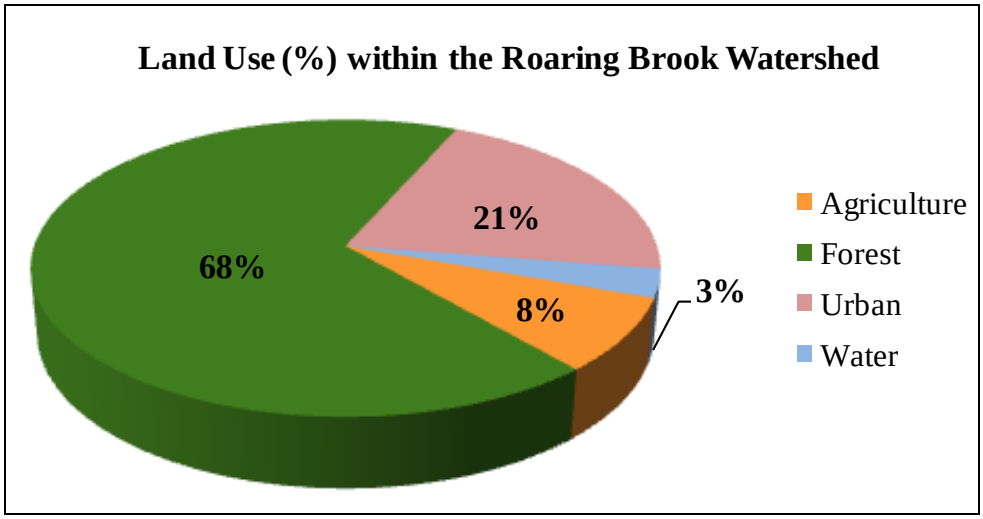
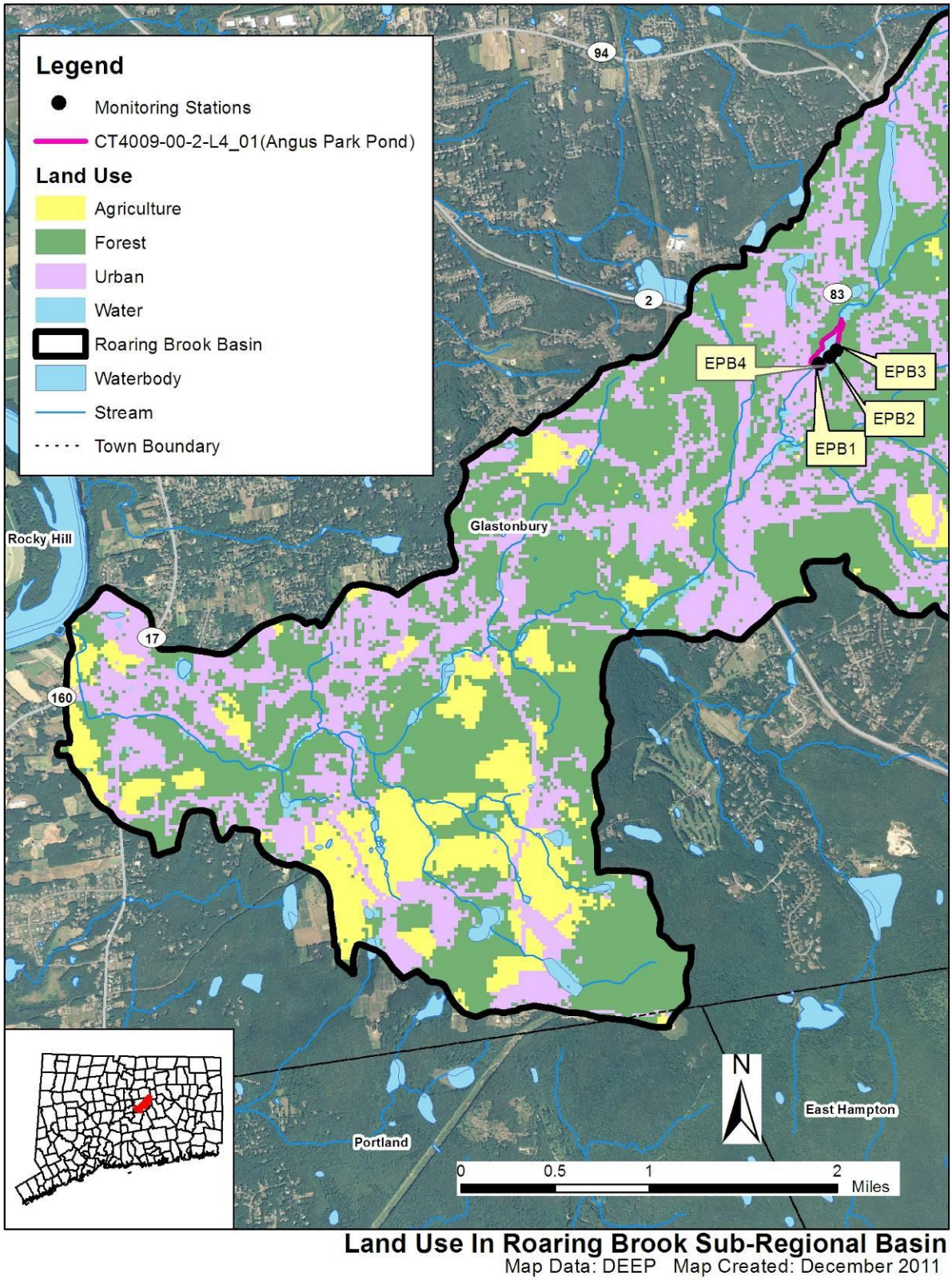


Figure 4: GIS map featuring land use for the Roaring Brook watershed at the sub-regional level



WHY IS A TMDL NEEDED?

E. coli is the indicator bacteria used for comparison with the CT state criteria in the CT Water Quality Standards (WQS) (CTDEEP, 2011). All data results are from CT DEEP, USGS, Bureau of Aquaculture or volunteer monitoring efforts at stations located on the impaired segment.

Table 2: Sampling Station Location Description for Angus Park Pond (Coordinates not available)

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT4009-00-2-L4_01	Angus Park Pond	EPB1	Deck	Glastonbury	--	--
CT4009-00-2-L4_01	Angus Park Pond	EPB2	Beach	Glastonbury	--	--
CT4009-00-2-L4_01	Angus Park Pond	EPB3	Wading	Glastonbury	--	--
CT4009-00-2-L4_01	Angus Park Pond	EPB4	Inlet	Glastonbury	--	--

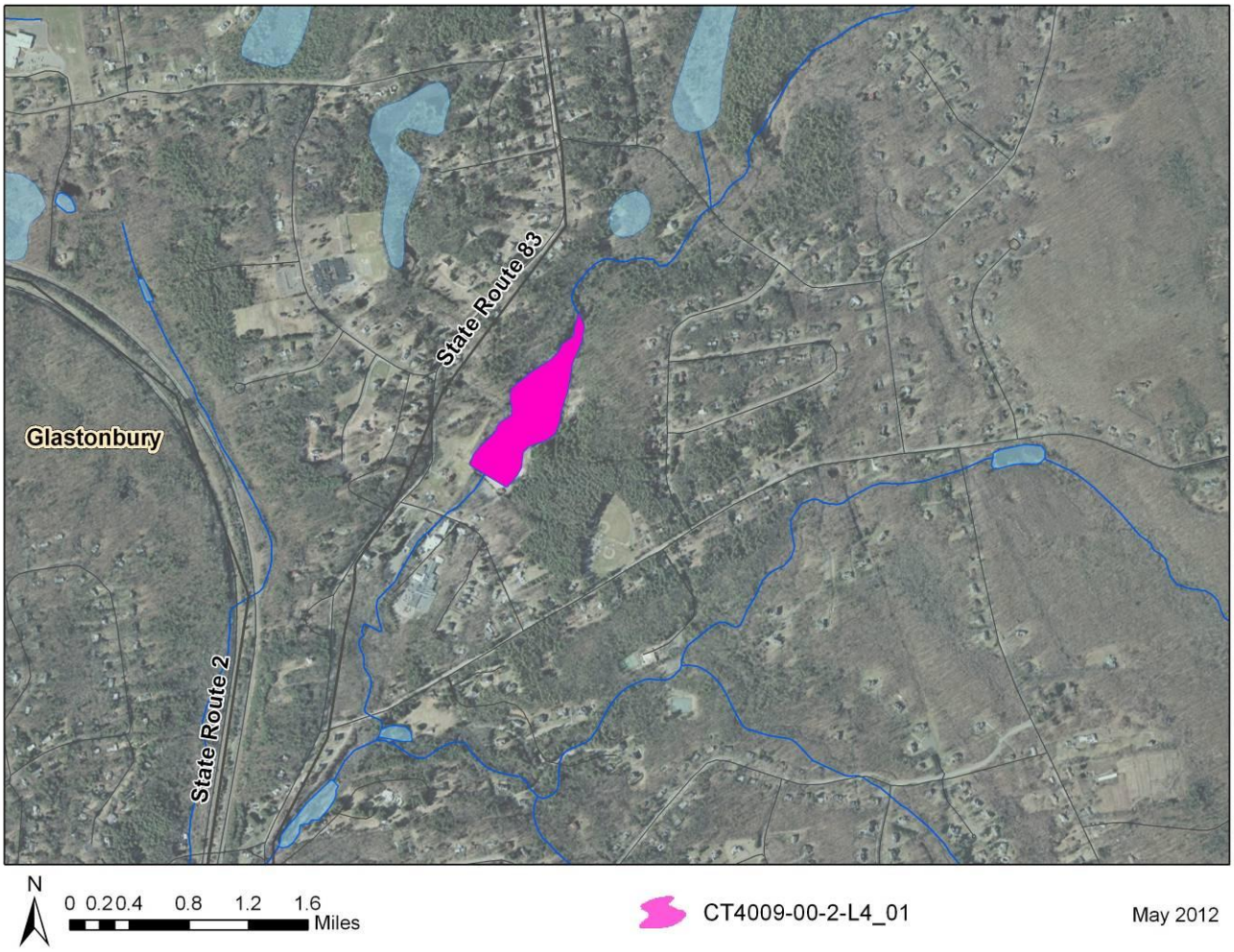
Angus Park Pond (CT4009-00-2-L4_01) is a Class A freshwater pond. Designated uses are potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. Water quality analyses were conducted using data from four sampling locations (Stations EPB1, EPB2, EPB3, and EPB4) on Angus Park Pond.

The water quality criteria for *E. coli*, along with bacteria sampling results from 2009-2011 are presented in Table 9 for Angus Park Pond. Single sample values for Stations EPB1, EPB2, and EPB3 were exceeded at least once in each sample year. Single sample values for Station EPB4 exceeded the WQS in 2009 and 2011. The annual geometric mean was calculated for these stations in each sample year. The only annual geometric mean that exceeded the WQS for *E. coli* was at EPB4 in 2009.

To aid in identifying possible bacteria sources, the geometric mean was also calculated for each station for wet-weather and dry-weather sampling days, where appropriate (Table 9). For the impaired segment of Angus Park Pond, the wet-weather geometric mean exceeded the WQS for *E. coli* at Stations EPB1, EPB3, and EPB4. The dry-weather geometric mean was not exceeded at any of the Stations on Angus Park Pond.

Due to the elevated bacteria measurements presented in Table 9, Angus Park Pond does not meet CT's bacteria WQS, was identified as impaired, and placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all water bodies to comply with state WQS.

Figure 5: Aerial map of Angus Park Pond



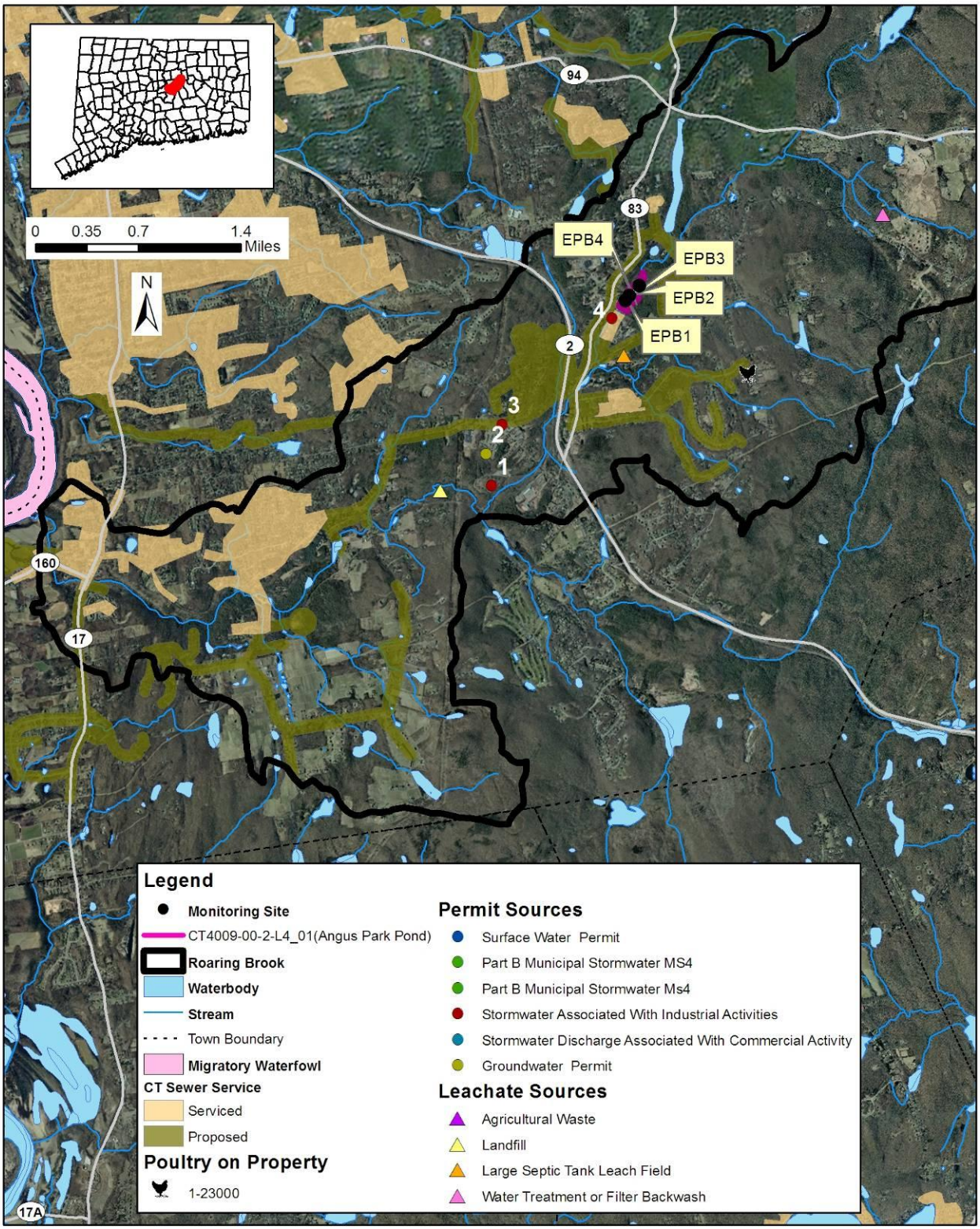
POTENTIAL BACTERIA SOURCES

Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the Roaring Brook watershed based on land use (Figures 2 and 4) and a collection of local information for the impaired waterbody is presented in Table 3 below and shown in Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study segment. Further monitoring and investigation will confirm listed sources and discover additional sources. Some segments in this watershed are currently listed as unassessed by CT DEEP procedures. This does not mean that there are no data nor that there are no impairments in existence in the segment. In some of these segments there are data from permitted sources and CT DEEP recommends that any elevated concentrations found from those permitted sources be addressed through voluntary reduction measures. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement these TMDLs.

Table 3: Potential bacteria sources to Angus Park Pond

Impaired Segment	Permit Source	Illicit Discharge	CSO/SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/ Pets	Other
Angus Park Pond CT4009-00	**x**	**x**		**x**		**x**	**x**	

Figure 6: Potential sources near Angus Park Pond in the Roaring Brook watershed



Potential Bacteria Sources In The Roaring Brook Sub Regional Basin
Map Data: DEEP Map Created: August 2011

The potential sources map for the impaired basin was developed after thorough analysis of available data sets. If information is not displayed in the map it is because no examples of that specific source were discovered to be present during the analysis of the basin. The following is the list of potential sources that were evaluated during analysis of the impaired basin: problems with migratory waterfowl, golf course locations, reservoirs, proposed and existing sewer service, cattle farms, poultry farms, permitted sources of bacteria loading (surface water discharge, MS4 permit, industrial stormwater, commercial stormwater, groundwater permits, and construction related stormwater), and leachate and discharge sources (agricultural waste, CSOs, failing septic systems, landfills, large septic tank leach fields, septage lagoons, sewage treatment plants, and water treatment or filter backwash).

Point Sources

Permitted sources exist within the watershed that could potentially contribute to the bacteria loading are identified in Table 4. This table includes permit types that may or may not be present in the impaired watershed. A list of active permits in the watershed is included in Table 6. Additional investigation and monitoring could reveal the presence of additional discharges in the watershed. Available effluent data from each of these permitted categories found within the watershed are compared to the CT State WQS for the appropriate receiving waterbody use and type. When available, bacteria data results from these permitted sources are listed in Table 6 if they are discharging near the impaired segment.

Table 4: General categories list of other permitted discharges

Permit Code	Permit Description Type	Number in watershed
CT	Surface Water Discharges	0
GPL	Discharge of Swimming Pool Wastewater	0
GSC	Stormwater Discharge Associated with Commercial Activity	0
GSI	Stormwater Associated with Industrial Activity	3
GSM	Part B Municipal Stormwater MS4	1
GSN	Stormwater Registration – Construction	0
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	2

Permitted Sources

As shown in Table 5, there are multiple permitted discharges in the Roaring Brook watershed. Bacteria data from 2001-2003 from one of these industrial permitted facilities are included in Table 6. This data cannot be compared to a water quality standard as Connecticut does not have a water quality standard to evaluate recreation use for fecal coliform bacteria. While none of the samples taken from Quality Name Plate (GSI000667) appear to be high, this discharge, and other permitted sources near the impaired segment (Figure 6) could still be potential sources of bacterial contamination to Angus Park Pond.

Since the MS4 permits are not targeted to a specific location, but the geographic area of the regulated municipality, there is no one accurate location on the map to display the location of these permits. One dot will be displayed at the geographic center of the municipality as a reference point. Sometimes this location falls outside of the targeted watershed and therefore the MS4 permit will not be displayed in the Potential Sources Map. Using the municipal border as a guideline will show which areas of an affected watershed are covered by an MS4 permit.

Table 5: Permitted facilities within the Roaring Brook watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
East Glastonbury	Quality Name Plate, Incorporated	GSI000667	Stormwater Associated With Industrial Activities	Quality Name Plate, Incorporated	4
Glastonbury	Town of Glastonbury	GSM00030	Part B Municipal Stormwater MS4	Glastonbury, Town of	N/A
Glastonbury	Town Of Glastonbury	GSI000607	Stormwater Associated With Industrial Activities	Glastonbury Transfer Station	1
Glastonbury	Town Of Glastonbury	GSI000621	Stormwater Associated With Industrial Activities	Glastonbury Town Garage	3
Glastonbury	Chestnut Hills Condominium Association	UI0000111	Groundwater Permit	Chestnut Hills Condominium	ND
Glastonbury	Chapin's Corner Condominium Association	UI0000375	Groundwater Permit	Chapin's Corner Condominium	2

ND= Not Displayed in Map

Table 6: Industrial permits in the Roaring Brook watershed and available fecal coliform data (colonies/100mL). The results cannot be compared to the water quality standard as there is no recreation standard for fecal coliform.

Town	Location	Permit Number	Receiving Water	Sample Location	Sample Date	Result
Glastonbury	Quality Name Plate	GSI667	Roaring Brook	Sample A	08/27/01	10
Glastonbury	Quality Name Plate	GSI667	Roaring Brook	Sample A	08/29/02	10
Glastonbury	Quality Name Plate	GSI667	Roaring Brook	Sample A	07/09/03	100
Glastonbury	Quality Name Plate	GSI667	Roaring Brook	Sample B	08/27/01	70
Glastonbury	Quality Name Plate	GSI667	Roaring Brook	Sample B	08/29/02	160
Glastonbury	Quality Name Plate	GSI667	Roaring Brook	Sample B	07/09/03	100
Glastonbury	Quality Name	GSI667	Roaring Brook	Sample C	08/27/01	10

Town	Location	Permit Number	Receiving Water	Sample Location	Sample Date	Result
	Plate					
Glastonbury	Quality Name Plate	GSI667	Roaring Brook	Sample C	08/29/02	350
Glastonbury	Quality Name Plate	GSI667	Roaring Brook	Sample C	07/09/03	100

Municipal Stormwater Permitted Sources

Per the EPA Phase II Stormwater rule all municipal storm sewer systems (MS4s) operators located within US Census Bureau Urbanized Areas (UAs) must be covered under MS4 permits regulated by the appropriate State agency. There is an EPA waiver process that municipalities can apply for to not participate in the MS4 program. In Connecticut, EPA has granted such waivers to 19 municipalities. All participating municipalities within UAs in Connecticut are currently regulated under MS4 permits by CT DEEP staff in the MS4 program.

The US Census Bureau defines a UA as a densely settled area that has a census population of at least 50,000. A UA generally consists of a geographic core of block groups or blocks that exceeds the 50,000 people threshold and has a population density of at least 1,000 people per square mile. The UA will also include adjacent block groups and blocks with at least 500 people per square mile. A UA consists of all or part of one or more incorporated places and/or census designated places, and may include additional territory outside of any place. (67 FR 11663)

For the 2000 Census a new geographic entity was created to supplement the UA blocks of land. This created a block known as an Urban Cluster (UC) and is slightly different than the UA. The definition of a UC is a densely settled area that has a census population of 2,500 to 49,999. A UC generally consists of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile. A UC consists of all or part of one or more incorporated places and/or census designated places; such a place(s) together with adjacent territory; or territory outside of any place. The major difference is the total population cap of 49,999 people for a UC compared to >50,000 people for a UA. (67 FR 11663)

While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some municipalities that appear to be within an MS4 program that are not currently regulated through an MS4 permit. This oversight can explain a municipality that is at least partially shaded grey in the maps and there are no active MS4 reporting materials or information included in the appropriate appendix. While these areas are not technically in the MS4 permit program, they are still considered urban by the cluster definition above and are likely to contribute similar stormwater discharges to affected waterbodies covered in this TMDL.

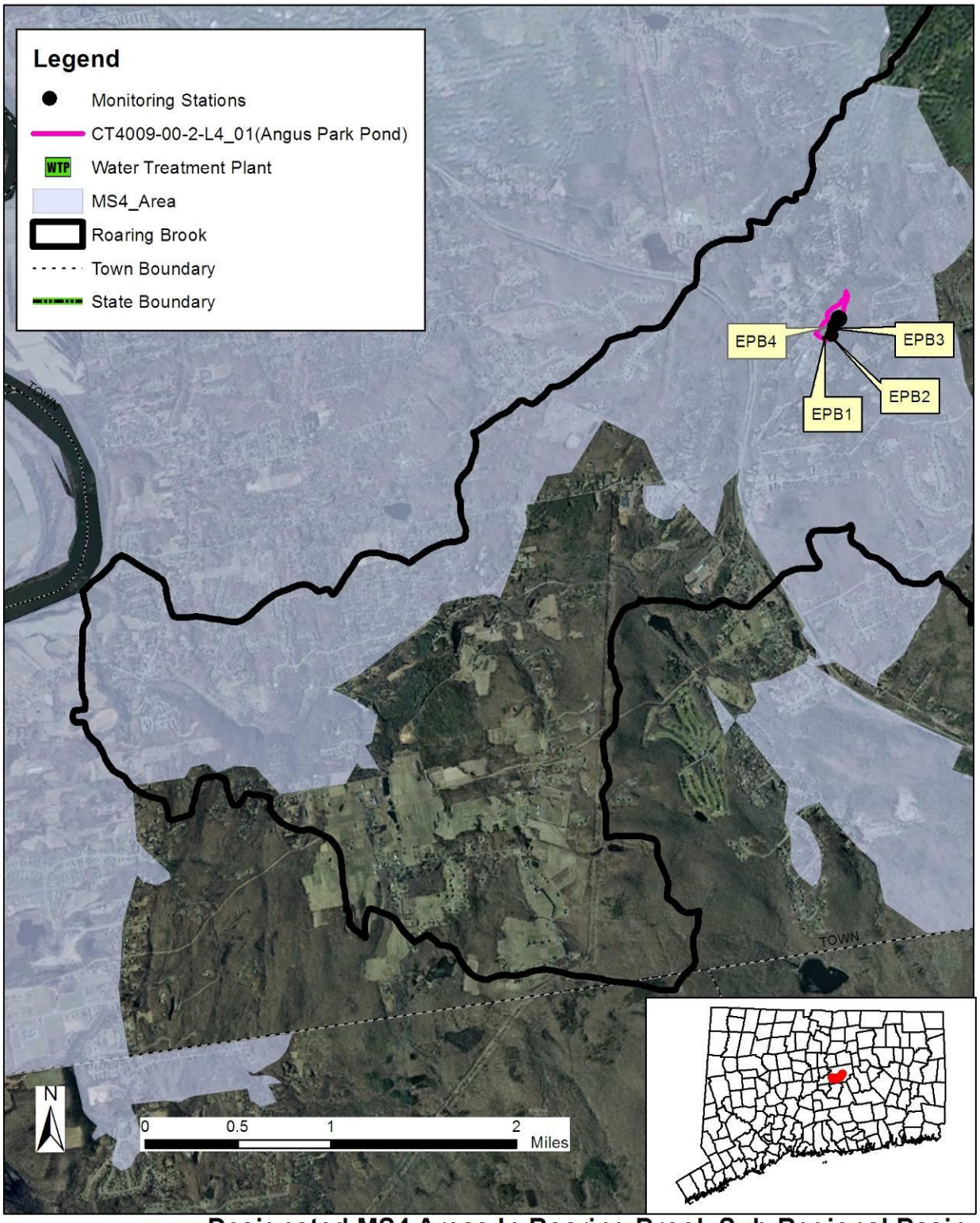
As previously noted, EPA can grant a waiver to a municipality to preclude their inclusion in the MS4 permit program. One reason a waiver could be granted is a municipality with a total population less than 1000 people, even if the municipality was located in a UA. There are 19 municipalities in Connecticut that have received waivers, this list is: Andover, Bozrah, Canterbury, Coventry, East Hampton, Franklin,

Haddam, Killingworth, Litchfield, Lyme, New Hartford, Plainfield, Preston, Salem, Sherman, Sprague, Stafford, Washington, and Woodstock. There will be no MS4 reporting documents from these towns even if they are displayed in an MS4 area in the maps of this document.

The list of US Census UCs is defined by geographic regions and is named for those regions, not necessarily by following municipal borders. In Connecticut the list of UCs includes blocks in the following Census Bureau regions: Colchester, Danielson, Lake Pocotopaug, Plainfield, Stafford, Storrs, Torrington, Willimantic, Winsted, and the border area with Westerly, RI (67 FR 11663). Any MS4 maps showing these municipalities may show grey areas that are not currently regulated by the CT DEEP MS4 permit program.

The watershed for the impaired segment is located within the Town of Glastonbury. Glastonbury has designated urban areas, as defined by the U.S. Census Bureau, and is required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the CT DEEP (Figure 10). This general permit is only applicable to municipalities that are identified in Appendix A of the MS4 permit that contain designated urban areas and discharge stormwater via a separate storm sewer system to surface waters of the State. The permit required municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants as well as to protect water quality. The MS4 permit is discussed further in the "TMDL Implementation Guidance" section of the core TMDL document. Additional information regarding stormwater management and the MS4 permit can be obtained on CT DEEP's website (www.ct.gov/dep/stormwater).

Figure 7: MS4 areas of the Roaring Brook watershed



Designated MS4 Areas In Roaring Brook Sub-Regional Basin
Map Data: DEEP Map Created: December 2011

Non-point Sources

Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture, and contract recreation (swimming or wading). Potential sources of NPS within the Roaring Brook watershed are described below.

Insufficient Septic Systems and Illicit Discharges

As shown in Figure 6, there are only several pockets of the watershed that have access to a sanitary sewer. Therefore, the majority of residents within the watershed rely on onsite wastewater treatment systems, such as septic systems. There are also many residential developments near the impaired segment which rely on septic systems. Insufficient or failing septic systems can be significant sources of bacteria by allowing raw waste to reach surface waters. Given the amount and proximity of many septic systems to the impaired segment, insufficient septic systems are a potential source of bacterial contamination to Angus Park Pond.

In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient of failing septic systems in a specific municipality. The Town of Glastonbury has its own Health Department (http://www.glasct.org/index.aspx?page=117) which handles septic systems within the town.

There are several areas within the watershed with access to a sanitary sewer or proposed access. Sewer system leaks and other illicit discharges that are located within the watershed of Angus Park Pond could be contributing bacteria to these water bodies.

Stormwater Runoff from Developed Areas

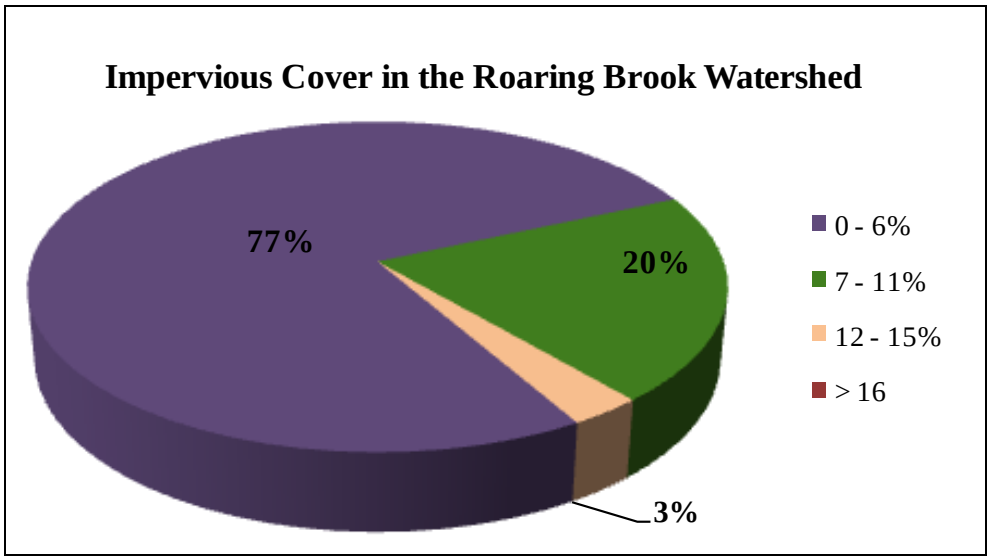
While much of the Roaring Brook watershed is undeveloped, there are multiple areas around Angus Park Pond that are developed. Approximately 21% of the land use in the watershed is considered urban (Figures 4 and 9). Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate into the soil. Past studies have shown a link between the amount of impervious area in a watershed and water quality conditions (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin et al., 2000).

Approximately 77% of the Roaring Brook watershed is characterized by land with 0 to 6% impervious cover, while 20% of the land is characterized by 7 to 11% and 3% of the land is characterized by 12 to 15% impervious cover. None of the land is characterized by >16% impervious (Figure 8). The most developed portions of the watershed consisting of 7 to 11% and 12 to 15% impervious cover are found around Angus Park Pond (Figure 9).

Examining the number of WQS exceedances found on "wet" sample dates can be an indication of stormwater runoff contributing bacterial contamination to surface waters. When rainwater passes over impervious surfaces it picks up a variety of pollutants, including bacteria, and carries those pollutants into surface waters with minimal treatment. At the Stations on Angus Park Pond there were a total of 29 single sample exceedances that could be categorized as either a wet or a dry weather sample. Of those identified exceedances, 23 out of the 29 (79%) were taken on wet weather days. The number of "wet" sample

exceedances, along with amount of impervious surfaces in the watershed, indicate that stormwater runoff from developed areas are a potential source of bacterial contamination.

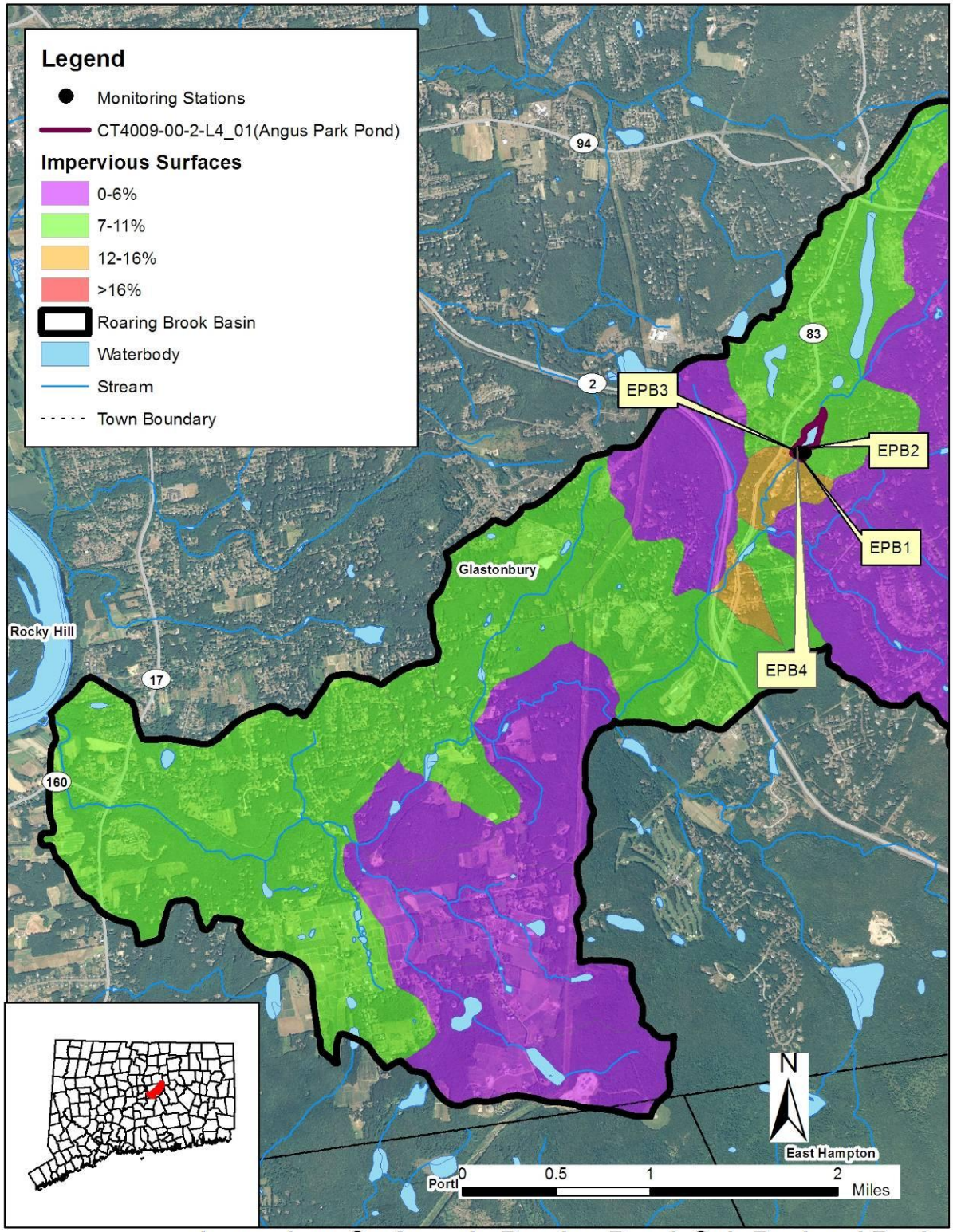
Figure 8: Range of impervious cover (%) in the Roaring Brook watershed



Agricultural Activities

Agricultural operations are an important economic activity and landscape feature in many areas of the State. Runoff from agricultural fields may contain pollutants such as bacteria and nutrients (USEPA, 2011a). This runoff can include pollutants from farm practices such as storing manure, allowing livestock to wade in nearby waterbodies, applying fertilizer, and reducing the width of a vegetated buffer along the shoreline. Agricultural land use makes up only 8% of the Roaring Brook watershed.

Figure 9: Impervious cover (%) for Roaring Brook sub-regional watershed



Impervious Surfaces In Roaring Brook Sub-Regional Basin
Map Data: DEEP Map Created: December. 2011

Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Roaring Brook watershed represent a potential source of bacteria. Wildlife, including waterfowl, may be a significant bacteria source to surface waters. With the construction of roads and drainage systems, these wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface water. These physical land alterations can exacerbate the impact of these natural sources on water quality (USEPA, 2001).

Angus Park Pond is located within Glastonbury's Angus Park. The open space in this park and the pond itself may provide an area for waterfowl to congregate. Geese and other waterfowl are known to congregate in open areas including recreational fields, golf courses, and agricultural crop fields. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas and cause water quality problems due to bacterial contamination associated with their droppings. In fact, conversations with municipal staff have acknowledged that geese are a problem at Angus Park Pond and are a likely source of bacteria impairments. Large populations of geese can also lead to habitat destruction as a result of overgrazing on wetland and riparian plants. This information makes wildlife waste a potential source of bacteria to Angus Park Pond.

Dense residential development surrounds much of Angus Park Pond in Glastonbury (Figure 5). Waste from domestic animals such as dogs, when not disposed of properly, can enter surface waters directly or through stormwater infrastructure. Therefore, domestic animal waste may also be contributing to bacteria concentrations in Angus Park Pond.

Additional Sources

There may be other sources not listed here or identified in Figure 6 which contribute to the observed water quality impairment in Angus Park Pond. Further monitoring and investigation will confirm the listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.

Land Use/Landscape

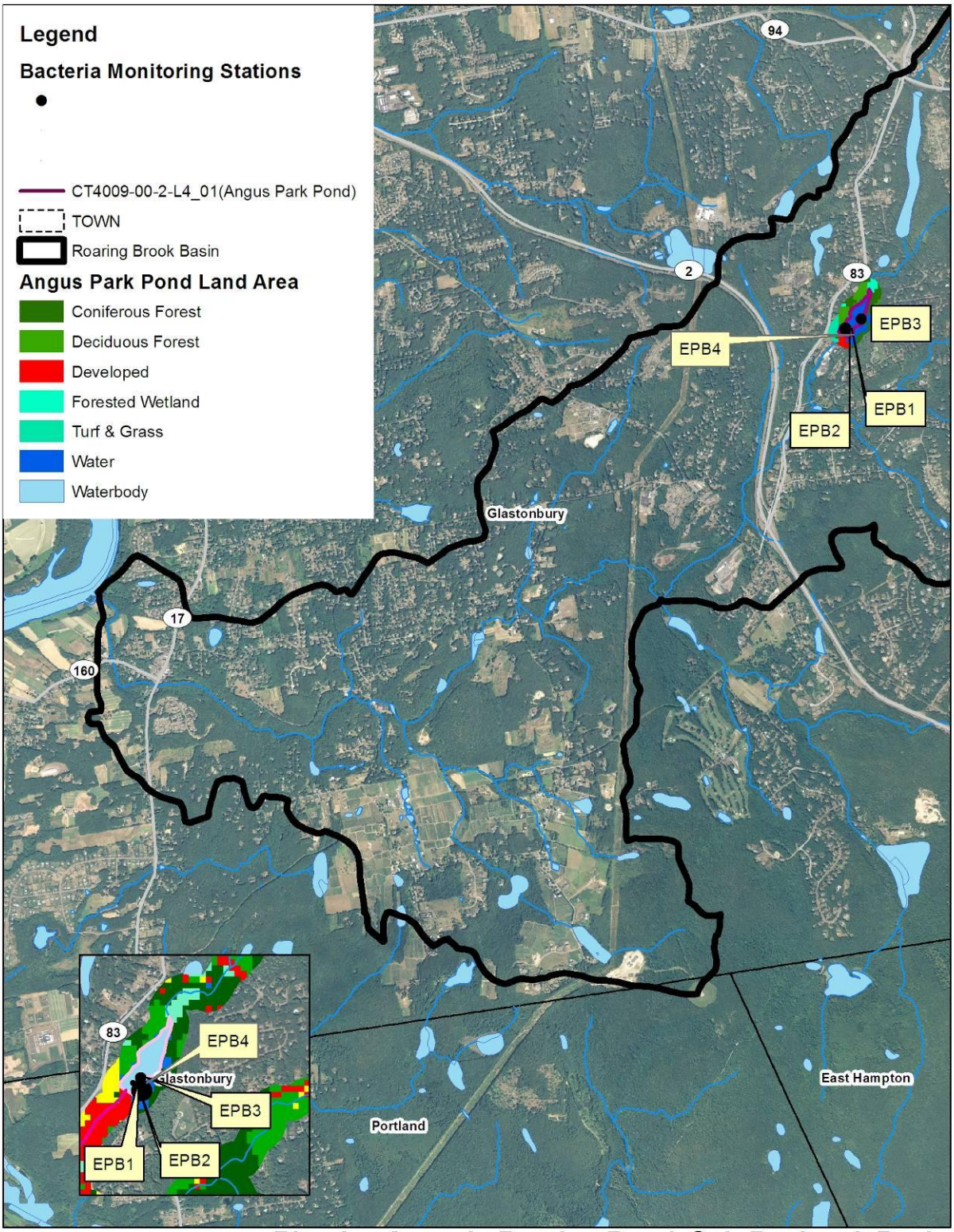
Riparian Buffer Zones

The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their unique soils, hydrology, and vegetation, natural riparian areas influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms. Any change to the natural riparian buffer zone can reduce the effectiveness of the natural buffer and has the potential to contribute to water quality impairment (USEPA, 2011b).

The CLEAR program at UCONN has created streamside buffer layers for the entire State of Connecticut (http://clear.uconn.edu/) which have been used in this TMDL. Analyzing this information can reveal potential sources and implementation opportunities at a localized level. The land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The majority of the riparian zone for Angus Park Pond is characterized by developed and forested land uses (Figure 10). As previously mentioned, developed areas are a potential source of bacteria.

Figure 10: Riparian buffer zone information for the Roaring Brook watershed



CURRENT MANAGEMENT ACTIVITIES

The Town of Glastonbury has developed and implemented some programs to protect water quality from bacterial contamination. As indicated previously, the portion of the watershed surrounding the impaired segment is regulated under the MS4 program. The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the state. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures:

1. Public Education and Outreach.
2. Public Involvement/Participation.
3. Illicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management in the new development and redevelopment.
6. Pollution prevention/good housekeeping for municipal operations.

Each municipality is also required to submit an annual update outlining the steps they are taking to meet the six minimum measures. All updates that address bacterial contamination in the watershed are summarized in Tables 7.

Table 7: Summary of MS4 requirement updates related to the reduction of bacterial contamination from Glastonbury, CT (Permit # GSM000030)

Minimum Measure	Glastonbury 2010 Annual Report
Public Outreach and Education	1) Partnered with Board of Education to add stormwater pollution prevention to school curriculum.
Public Involvement and Participation	1) Continued annual river bank clean-up efforts with student volunteers.
Illicit Discharge Detection and Elimination	1) Continued inspection program for outfall water quality. 2) Updated storm drain maps for recent subdivisions and road work.
Construction Site Stormwater Runoff Control	No updates.
Post Construction Stormwater Management	1) Revising ordinance to formalize implementation of BMPs.
Pollution Prevention and Good Housekeeping	No updates.

RECOMMENDED NEXT STEPS

As show above, the Town of Glastonbury has developed and implemented programs to protect water quality from bacterial contamination. Future mitigative activities are necessary to ensure the long-term protection Angus Park Pond and have been prioritized below.

1). Develop a system to monitor septic systems.

The majority of the residents in the watershed rely on septic systems to dispose of their waste. If not already in place, Glastonbury should establish a program to ensure that existing septic systems are properly operated and maintained. For instance, communities can create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of the sub-standard systems within a reasonable timeframe could also be adopted. Towns can also develop programs to assist citizens with the replacement and repair of older and failing systems

2). Identify areas along the more developed portions of Angus Park Pond to implement Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, the Town of Glastonbury within the Roaring Brook watershed is a MS4 community and thus, is regulated by the MS4 program. Since 21% of the watershed is considered urban and some of the areas with the highest percentage of impervious surfaces are near Angus Park Pond, stormwater runoff may be contributing bacteria to these waterbodies. To identify specific areas that are contributing bacteria to Angus Park Pond, the town should conduct wet-weather sampling at stormwater outfalls that discharge directly to Angus Park Pond. To treat stormwater runoff, the town should also identify areas near Angus Park Pond, to install BMPs designed to encourage stormwater to infiltrate into the ground before entering these waterbodies. These BMPs would disconnect impervious areas and reduce pollutant loads to Angus Park Pond. More detailed information and BMP recommendations can be found in the core TMDL document.

3). Implement a program to evaluate the sanitary sewer system.

Several areas around Angus Park Pond rely on a municipal sewer system (Figure 6). Since the sanitary sewer surrounds portions of Angus Park Pond, ensuring there are no leaks or overflows from the sanitary sewer in this area should be made a priority. It is important for Glastonbury to develop a program to evaluate its sanitary sewer and reduce leaks and overflows, especially in the areas around Angus Park Pond. This program should include periodic inspections of the sewer line.

4). Evaluate the municipalities' education and outreach programs regarding animal waste.

Angus Park Pond is within Angus Park. Any education and outreach programs within Glastonbury should highlight the importance of not feeding waterfowl and wildlife, picking up after, dogs, and other pets within Angus Park. The town and residents can take measures to minimize waterfowl-related impacts such as allowing tall, coarse vegetation to grow in the riparian areas around Angus Park Pond that are frequented by waterfowl. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shore will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl,

such as ducks, geese, and swans may contribute to water quality impairments in Angus Park Pond, and can harm human health and the environment.

Animal wastes should be disposed of away from any waterbody or storm drain system. BMPs effective at reducing the impact of animal waste on water quality include installing signage, providing pet waste receptacles in high-uses areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.

5). Continue monitoring of permitted sources.

Previous sampling of the permitted discharges in the Roaring Brook watershed (Table 6) has not shown very high readings of fecal coliform bacteria. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility is an additional recommendation. Monitoring should continue on all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection. Table 8details the appropriate waste load allocations established by this TMDL for use as water quality targets for permittees as permits are renewed and updated, within the Roaring Brook watershed.

For any municipality subject to an MS4 permit and affected by a TMDL, the permit requires a modification of the SMP to include BMPs that address the included impairment. In the case of bacteria related impairments municipal BMPs could include: implementation or improvement to existing nuisance wildlife programs, septic system monitoring programs, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) programs, and increased street sweeping above basic permit requirements. Any non-MS4 municipalities can implement these same types of initiatives in effort to reduce bacteria source loading to impaired waterways.

Any facilities that discharge non-MS4 regulated stormwater should update their Pollution Prevention Plan to reflect BMPs that can reduce bacteria loading to the receiving waterway. These BMPs could include nuisance wildlife control programs and any installations that increase surface infiltration to reduce overall stormwater volumes. Facilities that are regulated under the Commercial Activities Stormwater Permit should report any updates to their SMP in their summary documentation submitted to DEEP.

Table 8. Water Quality Criteria for Receiving Waters Affected by this TMDL

		Instantaneous *E. coli* (#/100mL)						Geometric Mean *E. coli* (#/100mL)	
Class	**Bacteria Source**	**WLA[6]**			**LA[6]**			**WLA[6]**	**LA[6]**
	Recreational Use	1	2	3	1	2	3	**All**	**All**
A	Non-Stormwater NPDES	0	0	0				0	
	CSOs	0	0	0				0	
	SSOs	0	0	0				0	
	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235[7]	410[7]	576[7]				126[7]	

	Stormwater (non-MS4)				235[7]	410[7]	576[7]		126[7]
	Wildlife direct discharge				235[7]	410[7]	576[7]		126[7]
	Human or domestic animal direct discharge[5]				235	410	576		126

(1) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protections and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.

(2) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.

(3) **All Other Recreational Uses.**

(4) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of sewage treatment plant effluents is not required consistent with Standard 23. (Class B surface waters located north of Interstate Highway I-95 and downstream of a sewage treatment plant providing seasonal disinfection May 1 through October 1, as authorized by the Commissioner.)

(5) Human direct discharge = swimmers

(6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations

(7) These values can be “as naturally occurs” if the only pollutant source is wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL

Table 9: Angus Park Pond Bacteria Data

Waterbody ID: CT4009-00-2-L4_01

Characteristics: Freshwater, Class A, Potential Drinking Water Source, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply

Impairment: Recreation (*E. coli bacteria)*

Water Quality Criteria for E. coli:

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:

Geometric Mean: **7%**

Single Sample: **88%**

Data: 2011 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Angus Park Pond with annual geometric means calculated by station (notes located at the end of the table)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
EPB1	Sample from deck	6/10/2009	700	wet	96
EPB1	Sample from deck	6/11/2009	210	dry	
EPB1	Sample from deck	6/17/2009	10	dry	
EPB1	Sample from deck	6/26/2009	10	wet	
EPB1	Sample from deck	6/30/2009	360	dry	
EPB1	Sample from deck	7/1/2009	560	dry	
EPB1	Sample from deck	7/2/2009	250	wet	
EPB1	Sample from deck	7/3/2009	280	wet	
EPB1	Sample from deck	7/4/2009	60	dry	
EPB1	Sample from deck	7/7/2009	53	wet	
EPB1	Sample from deck	7/13/2009	10	dry	
EPB1	Sample from deck	7/22/2009	780	wet	
EPB1	Sample from deck	7/23/2009	240	wet	
EPB1	Sample from deck	7/24/2009	1700	wet	

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
EPB1	Sample from deck	7/25/2009	200	wet	
EPB1	Sample from deck	7/26/2009	80	dry	
EPB1	Sample from deck	7/28/2009	120	dry	
EPB1	Sample from deck	7/29/2009	64	wet	
EPB1	Sample from deck	8/3/2009	42	dry	
EPB1	Sample from deck	8/10/2009	10	dry	
EPB1	Sample from deck	8/17/2009	63	dry	
EPB1	Sample from deck	8/24/2009	10	dry	
EPB1	Sample from deck	9/1/2009	64	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Angus Park Pond with annual geometric means calculated by station (notes located at the end of the table)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
EPB1	Sample from deck	6/14/2010	590	dry	
EPB1	Sample from deck	6/15/2010	10	dry	
EPB1	Sample from deck	6/21/2010	75	dry	
EPB1	Sample from deck	6/28/2010	20	dry	
EPB1	Sample from deck	7/8/2010	10	dry	
EPB1	Sample from deck	7/12/2010	87	dry	
EPB1	Sample from deck	7/19/2010	31	wet	
EPB1	Sample from deck	7/27/2010	75	dry	37
EPB1	Sample from deck	8/2/2010	10	dry	
EPB1	Sample from deck	8/9/2010	10	dry	
EPB1	Sample from deck	8/10/2010	10	dry	
EPB1	Sample from deck	8/16/2010	74	wet	
EPB1	Sample from deck	8/24/2010	500	wet	
EPB1	Sample from deck	8/26/2010	10	wet	
EPB1	Sample from deck	8/30/2010	42	dry	
EPB1	Sample from deck	6/13/2011	530	unknown	
EPB1	Sample from deck	6/14/2011	160	unknown	
EPB1	Sample from deck	6/15/2011	180	unknown	
EPB1	Sample from deck	6/21/2011	99	unknown	62
EPB1	Sample from deck	6/22/2011	140	unknown	
EPB1	Sample from deck	6/27/2011	53	unknown	
EPB1	Sample from deck	7/5/2011	31	unknown	

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
EPB1	Sample from deck	7/11/2011	10	unknown	
EPB1	Sample from deck	7/12/2011	20	unknown	
EPB1	Sample from deck	7/13/2011	10	unknown	
EPB1	Sample from deck	7/18/2011	75	unknown	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Angus Park Pond with annual geometric means calculated by station (notes located at the end of the table)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
EPB2	Sample from beach	6/10/2009	360	wet	75
EPB2	Sample from beach	6/11/2009	120	dry	
EPB2	Sample from beach	6/17/2009	10	dry	
EPB2	Sample from beach	6/26/2009	10	wet	
EPB2	Sample from beach	6/30/2009	110	dry	
EPB2	Sample from beach	7/1/2009	120	dry	
EPB2	Sample from beach	7/2/2009	310	wet	
EPB2	Sample from beach	7/7/2009	10	wet	
EPB2	Sample from beach	7/13/2009	20	dry	
EPB2	Sample from beach	7/22/2009	950	wet	
EPB2	Sample from beach	7/24/2009	1300	wet	
EPB2	Sample from beach	7/28/2009	240	dry	
EPB2	Sample from beach	7/29/2009	64	wet	
EPB2	Sample from beach	8/3/2009	75	dry	
EPB2	Sample from beach	8/10/2009	10	dry	
EPB2	Sample from beach	8/17/2009	30	dry	
EPB2	Sample from beach	8/24/2009	64	dry	
EPB2	Sample from beach	9/1/2009	64	dry	
EPB2	Sample from beach	6/14/2010	10	dry	27
EPB2	Sample from beach	6/15/2010	10	dry	
EPB2	Sample from beach	6/21/2010	75	dry	
EPB2	Sample from beach	6/28/2010	10	dry	
EPB2	Sample from beach	7/8/2010	10	dry	
EPB2	Sample from beach	7/12/2010	75	dry	
EPB2	Sample from beach	7/19/2010	10	wet	
EPB2	Sample from beach	7/27/2010	87	dry	

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
EPB2	Sample from beach	8/2/2010	20	dry	
EPB2	Sample from beach	8/9/2010	42	dry	
EPB2	Sample from beach	8/10/2010	10	dry	
EPB2	Sample from beach	8/16/2010	96	wet	
EPB2	Sample from beach	8/24/2010	700	wet	
EPB2	Sample from beach	8/26/2010	10	wet	
EPB2	Sample from beach	8/30/2010	10	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Angus Park Pond with annual geometric means calculated by station (notes located at the end of the table)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
EPB3	Sample from wading	6/10/2009	740	wet	
EPB3	Sample from wading	6/11/2009	220	dry	
EPB3	Sample from wading	6/17/2009	31	dry	
EPB3	Sample from wading	6/26/2009	10	wet	
EPB3	Sample from wading	6/30/2009	140	dry	
EPB3	Sample from wading	7/1/2009	270	dry	
EPB3	Sample from wading	7/2/2009	430	wet	
EPB3	Sample from wading	7/3/2009	560	wet	
EPB3	Sample from wading	7/4/2009	180	dry	
EPB3	Sample from wading	7/7/2009	53	wet	
EPB3	Sample from wading	7/13/2009	10	dry	
EPB3	Sample from wading	7/22/2009	500	wet	119
EPB3	Sample from wading	7/23/2009	240	wet	
EPB3	Sample from wading	7/24/2009	2000*	wet	
EPB3	Sample from wading	7/25/2009	200	wet	
EPB3	Sample from wading	7/26/2009	80	dry	
EPB3	Sample from wading	7/28/2009	220	dry	
EPB3	Sample from wading	7/29/2009	31	wet	
EPB3	Sample from wading	8/3/2009	42	dry	
EPB3	Sample from wading	8/10/2009	99	dry	
EPB3	Sample from wading	8/17/2009	52	dry	
EPB3	Sample from wading	8/24/2009	75	dry	
EPB3	Sample from wading	9/1/2009	31	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Angus Park Pond with annual geometric means calculated by station (notes located at the end of the table) (Continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
EPB3	Sample from wading	6/14/2010	10	dry	45
EPB3	Sample from wading	6/21/2010	110	dry	
EPB3	Sample from wading	6/28/2010	10	dry	
EPB3	Sample from wading	7/8/2010	10	dry	
EPB3	Sample from wading	7/12/2010	120	dry	
EPB3	Sample from wading	7/19/2010	31	wet	
EPB3	Sample from wading	7/27/2010	53	dry	
EPB3	Sample from wading	8/2/2010	42	dry	
EPB3	Sample from wading	8/9/2010	530	dry	
EPB3	Sample from wading	8/10/2010	190	dry	
EPB3	Sample from wading	8/16/2010	10	wet	
EPB3	Sample from wading	8/24/2010	380	wet	
EPB3	Sample from wading	8/26/2010	20	wet	
EPB3	Sample from wading	8/30/2010	20	dry	
EPB3	Sample from wading	6/13/2011	620	unknown	107
EPB3	Sample from wading	6/14/2011	270	unknown	
EPB3	Sample from wading	6/15/2011	75	unknown	
EPB3	Sample from wading	6/21/2011	360	unknown	
EPB3	Sample from wading	6/22/2011	210	unknown	
EPB3	Sample from wading	6/27/2011	53	unknown	
EPB3	Sample from wading	7/5/2011	20	unknown	
EPB3	Sample from wading	7/11/2011	310	unknown	
EPB3	Sample from wading	7/12/2011	220	unknown	
EPB3	Sample from wading	7/13/2011	31	unknown	
EPB3	Sample from wading	7/18/2011	10	unknown	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Angus Park Pond with annual geometric means calculated by station (notes located at the end of the table) (Continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
EPB4	Sample from Inlet	7/3/2009	520	wet	135*
EPB4	Sample from Inlet	7/4/2009	160	dry	

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
EPB4	Sample from Inlet	7/7/2009	42	wet	
EPB4	Sample from Inlet	7/13/2009	20	dry	
EPB4	Sample from Inlet	7/22/2009	590	wet	
EPB4	Sample from Inlet	7/23/2009	160	wet	
EPB4	Sample from Inlet	7/24/2009	830	wet	
EPB4	Sample from Inlet	7/25/2009	320	wet	
EPB4	Sample from Inlet	7/26/2009	120	dry	
EPB4	Sample from Inlet	7/28/2009	150	dry	
EPB4	Sample from Inlet	7/29/2009	64	wet	
EPB4	Sample from Inlet	8/3/2009	31	dry	
EPB4	Sample from Inlet	8/10/2009	110	dry	
EPB4	Sample from Inlet	8/17/2009	190	dry	
EPB4	Sample from Inlet	8/24/2009	110	dry	
EPB4	Sample from Inlet	9/1/2009	87	dry	
EPB4	Sample from Inlet	6/14/2010	210	dry	
EPB4	Sample from Inlet	6/15/2010	10	dry	
EPB4	Sample from Inlet	6/21/2010	110	dry	
EPB4	Sample from Inlet	6/28/2010	150	dry	
EPB4	Sample from Inlet	7/8/2010	10	dry	
EPB4	Sample from Inlet	7/12/2010	64	dry	
EPB4	Sample from Inlet	7/19/2010	64	wet	
EPB4	Sample from Inlet	7/27/2010	75	dry	43
EPB4	Sample from Inlet	8/2/2010	10	dry	
EPB4	Sample from Inlet	8/9/2010	31	dry	
EPB4	Sample from Inlet	8/10/2010	20	dry	
EPB4	Sample from Inlet	8/16/2010	160	wet	
EPB4	Sample from Inlet	8/24/2010	140	wet	
EPB4	Sample from Inlet	8/26/2010	20	wet	
EPB4	Sample from Inlet	8/30/2010	10	dry	

Single sample *E. coli* (colonies/100 mL) data from all monitoring stations on Angus Park Pond with annual geometric means calculated by station (notes located at the end of the table) (Continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
EPB4	Sample from Inlet	6/13/2011	740	unknown	101

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
EPB4	Sample from Inlet	6/14/2011	10	unknown	
EPB4	Sample from Inlet	6/15/2011	10	unknown	
EPB4	Sample from Inlet	6/21/2011	160	unknown	
EPB4	Sample from Inlet	6/22/2011	210	unknown	
EPB4	Sample from Inlet	6/27/2011	87	unknown	
EPB4	Sample from Inlet	7/5/2011	150	unknown	
EPB4	Sample from Inlet	7/11/2011	180	unknown	
EPB4	Sample from Inlet	7/12/2011	250	unknown	
EPB4	Sample from Inlet	7/13/2011	180	unknown	
EPB4	Sample from Inlet	7/18/2011	42	unknown	

Shaded cells indicate an exceedance of water quality criteria

**** Weather conditions for selected data taken from Hartford because local station had missing data**

***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather geometric mean values for all monitoring stations on Angus Park Pond

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
EPB1	Sample from deck	2009-2010	14	24	66	141	42
EPB2	Sample from beach	2009-2010	11	22	47	95	33
EPB3	Sample from wading	2009-2010	14	23	82	128	63
EPB4	Sample from Inlet	2009-2010	11	20	77	152	53

Shaded cells indicate an exceedance of water quality criteria

Weather condition determined from rain gage at Markham Municipal KMMK station in Meriden, CT

REFERENCES

Costa, Joe (2011). Calculating Geometric Means. Buzzards Bay National Estuary Program. **Online**: http://www.buzzardsbay.org/geomean.htm

CTDEEP (2011). State of Connecticut Water Quality Standards. **Online:** http://www.ct.gov/dep/lib/dep/water/water_quality_standards/wqs_final_adopted_2_25_11.pdf

CTDEEP (2010). State of Connecticut Integrated Water Quality Report. **Online:** http://www.ct.gov/dep/lib/dep/water/water_quality_management/305b/ctiwqr10final.pdf

CWP (2003). Impacts of Impervious Cover on Aquatic Systems. Center for Watershed Protection. **Online**: http://clear.uconn.edu/projects/tmdl/library/papers/Schueler_2003.pdf

Federal Register 67 (March 15, 2002) 11663-11670. Urban Area Criteria for Census 2000

Mallin, M.A., K.E. Williams, E.C. Escham, R.P. Lowe (2000). Effect of Human Development on Bacteriological Water Quality in Coastal Wetlands. Ecological Applications 10: 1047-1056.

USEPA (2001). Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water. **Online**: http://www.epa.gov/safewater/sourcewater/pubs/fs_swpp_petwaste.pdf.

USEPA (2011a). Managing Nonpoint Source Pollution from Agriculture. **Online:** http://water.epa.gov/polwaste/nps/outreach/point6.cfm

USEPA (2011b). Riparian Zone and Stream Restoration. **Online:** http://epa.gov/ada/eco/riparian.html